

history of the system Krueger 60, and from his fine series of measures shows that the close pair is a short-period binary, and that the parallax is  $0''.249$ .

In *M.N.*, June, Dr. See, in a paper on the "Comparative Eccentricities of Visual and Spectroscopic Binaries," shows that the average eccentricity among visual binaries is more than twice that among spectroscopic.

Dr. Abetti, in *A.N.* 4270, gives the parallax of  $61^1$  Cygni as  $0''.24$ , and of  $61^2$  Cygni as  $0''.22$ ; and in *A.N.* 4250 Professor G. Comstock is able to reconcile, *inter se*, the measures of the small stars near 70 Ophiuchi by assuming the masses of the two components equal.

A series of articles by Mr. Lewis have appeared in several numbers of the *Observatory*, on the history of double star work, the computation of orbits, and on formulæ connected with orbital planes, masses, parallax, magnitudes, etc. The editors are issuing the collected articles in a small book.

One of the most important works of the year is *Publikationen des Astrophysikalischen Observatoriums zu Potsdam*. This volume by Dr. Lohse is divided into two parts:—

1. The measures made by Dr. Lohse with the 11-inch refractor during the years 1899 to 1907.
2. Computation of orbits.

Dr. Lohse measured 166 selected pairs, and, where possible, he has also collected previous measures and deduced orbits. Altogether he computes twenty-nine orbits:— $\beta$  524 (27.3),  $\beta$  883 (17.0),  $\beta$  621 (34.4),  $\xi$  Bootis (159.5),  $\Sigma$  3062 (114.2),  $\eta$  Cassiopeiæ (345.6), Sirius (49.3), Castor (297.5),  $\gamma$  Argus (23.5),  $\Sigma$  3121 (35.1),  $O\Sigma$  235 (69.7),  $\gamma$  Virginis (177.8),  $\alpha$  Centauri (78.8),  $\xi$  Bootis (170.6),  $\eta$  Coronæ (40.6),  $\mu_2$  Bootis (244.4),  $\xi$  Scorpii (44.7),  $\lambda$  Ophiuchi, (123.2),  $\Sigma$  2107 (134.6),  $\Sigma$  2173 (45.7),  $\mu_1$  Herculis (44.7), 70 Ophiuchi (87.9), 99 Herculis (53.5),  $\beta$  648 (50.9),  $O\Sigma$  387 (90),  $\beta$  151 (27.0),  $\tau$  Cygni (48.5), and  $\kappa$  Pegasi (11.2). There is a review in *Observatory*, No. 405. T. L.

### Variable Stars.

The discovery of new variable stars seems to have gone on in 1908 at about the same rate as in the preceding year, the latest provisional designation given in the *A.N.* for 1908 being No. 171. Harvard College Observatory, as before, is responsible for a large proportion of these. In *H.C.O. Circulars*, Nos. 135, 137, 139, and 140 to 143, no less than 152 new variables are announced. Of this number 148 form part of the 171 just referred to.

Dr. J. Hartmann finds that the spectrum of the celebrated Nova Persei 1901 changed to the nebular condition towards the end of 1902, while in 1906 it changed again to that of the Wolf-Rayet stars. Professor E. E. Barnard has observed that changes in

the focus for this star in the 40-inch refractor of the Yerkes Observatory coincide with Dr. Hartmann's work. At first (1901) the focus was the same as that of an ordinary star. Between 1902 August 29 and October 6 the focal length increased nearly a quarter of an inch, and was the same as for a nebula. By the end of January 1903 the focus had again become stellar (*A.N.*, 4232, 4285).

In *H.C.O. Annals*, vol. lxiv. pt. ii., is published a monograph on the variable *SS Cygni*. The normal magnitude is 11.8 for two-thirds of the time. During the remainder the star rises capriciously to various magnitudes, ranging up to 8.8, and at present there seems to be no law known which will correlate these curious outbursts of light. It may be noted here that this variable is under special scrutiny by the variable star section of the *B.A.A.*; and during 1908, 747 observations have been secured, well covering every phase of its irregular fluctuations in that year.

Mr. J. Van der Bilt has also (*Recherches Astronomiques de l'Observatoire d'Utrecht*, iii.) dealt exhaustively with a variable of similar class, the well-known *U Geminorum*. He sums up his conclusions as follows: "All attempts to detect some law in the changes of the period have failed; and it is to be feared that this will remain so until a long series of observations, as continuous as the position of *U Geminorum* in the ecliptic allows, constitute a more complete basis for further inquiry. As the material now lies before us, only useless speculations can result from it."

Much good work is being done at the Laws Observatory, University of Missouri, by photometric observations of certain variables discovered in recent years. Two forms of instrument are used: (1) A disc photometer, by means of which "the apparent intensity of a luminous source can be diminished by a definite and known amount. It consists essentially of a rotating disc, from which a number of sector-shaped areas have been cut away," and the artificial source of light is made equal in intensity to the star under observation. (2) The wedge photometer is on the principle of that of Zöllner, in which an artificial star is formed in the telescope alongside the real one. The intensity of the former is varied until the two images are equal. The so-called "wedge" is really a strip of photographic negative in which the blackening of the film increases from one end to the other.

Mr. T. H. Astbury, a member of the *B.A.A.*, has recently discovered a new variable of the Algol type, provisional designation 16, 1908 Vulpeculæ. It is B.D. + 22°, 3647. The period is 4.47 d., variation 6.7 m. to 8.0 m. The same observer has confirmed (independently) the variation of 26, 1900 Vulpeculæ = B.D. + 25°, 3803. This also is of Algol type; period probably about 5 d., variation 7.3 m. to 8.3 m.

Series vi. of the *Atlas Stellarum Variabilium* has now appeared, thus completing the original scheme of the work. It is on the same lines as the other sections, and the whole work forms a thoroughly accurate guide (by chart, and by list of comparison

stars) in the observation of over 300 variables. We must congratulate Father Hagen on the completion of this, his great task.

Vol. lviii. of the *R.A.S. Memoirs* contains the observations of thirty-one variable stars, principally of long period, made by the late N. R. Pogson in the years 1852–1880, but left unpublished by the observer. They have been edited with great care by Mr. C. L. Brook, M.A., F.R.Met.Soc., the introduction being by Prof. H. H. Turner, F.R.S. The observations are valuable as connecting the time of Argelander with the period when the study of stellar variation began to get more general; and they are also of interest as having been made by an astronomer who himself discovered at least fifteen variable stars, and established the light ratio (2.512) now generally adopted. Pogson's good work must be of great use to all who are engaged in the study of long-period stellar variations. The magnitudes of the comparison stars are carefully reduced, and the notation adopted in the record, indicating the comparison star by its magnitude, enables the resulting magnitude to be checked at a glance by the reader. A chart of the vicinity of each variable is given, and other information of much value is contained in the volume.

The following three important works connected with stellar photometry, and therefore incidentally with variable stars, may be briefly noticed here.

The *Revised Harvard Photometry* (vol. I., *Annals H.C.O.*) gives a catalogue of the brightness and spectra of 9110 stars, distributed over the whole sky, and chiefly brighter than 6.50 m. This brings together in a convenient form the previous results of the photometric work of H.C.O.; and a comparison of the mean magnitude of each star now given is made with the former determinations, as well as with the catalogues of Sir William and Sir John Herschel, the U.N. Oxon., Potsdam, and of A. S. Williams. It may be noted that the letters H.R. followed by a number represent a star in this catalogue.

Vol. liv. of the *Annals H.C.O.* is “*A Catalogue of 36,682 stars fainter than the magnitude 6.50 observed with the 4-inch Meridian Photometer.*” This work also represents the outcome of previous observations scattered through several volumes of the *Annals*, and extends over the whole sky. Owing to the large number of stars, and the consequent necessary economy of space, the entry against each star is more condensed than in vol. I., but the B.D. number, position, magnitude, number of observations, and reference to previous vols. of the *Annals* are given.

These two volumes, then, form a complete catalogue, and, as it were, crown the labours of light-gauging carried on at H.C.O. for close on thirty years with such admirable tenacity of purpose by Professor E. C. Pickering and his staff.

The *Photometric Durchmusterung of Potsdam* is contained in vol. xvii. of the Publications of that Observatory, prepared under the direction of the late Professor Vogel. It gives the position and brightness of all the stars in the northern heavens

brighter than 7.5 m., the number being 14,199. The magnitudes were obtained by Müller and Kempf, with a Zöllner Photometer, during the years 1886 to 1905, and are very carefully determined. Comparing with the work of H.C.O., however, it is at once seen that there are considerable differences in brightness; hence, for the present, the second decimal of a star's magnitude may be regarded as more or less a figment, and it will be so until a more accurate standard of stellar light-measurement is obtained. Yet, with the three volumes just referred to, astronomers possess a most valuable record of the brightness of many thousands of stars, which will doubtless be of the greatest use for reference, comparison, etc. in various stellar researches.

E. E. M.

### *Stellar Distribution and Drift.*

Professor Lewis Boss (*Astronomical Journal*, No. 604), from the results of his determinations of proper motions of fundamental stars, has arrived at an interesting conclusion with regard to a number of stars in Taurus. He finds that thirty-nine stars, mostly brighter than the sixth magnitude, have proper motions accurately directed to a single point of the celestial sphere. The mean deviation in position angle of the proper motions is  $\pm 1^\circ.8$ . It appears that these stars form a globular cluster about  $15^\circ$  in diameter, having a central condensation; we may expect that many fainter stars will be found to belong to the cluster as soon as their motions have been determined with sufficient accuracy. The great angular dimensions of the cluster are due to its comparative nearness to the Earth at present; for example, it is estimated that in about sixty million years this Taurus-stream will appear as an ordinary globular cluster about 20' in diameter, constituted of stars of magnitudes 9-12. If this system is to be taken as typical of globular clusters in general, it would indicate that their linear dimensions may be much greater than is often supposed, for in this case it is clear that the distances of the component stars from each other cannot be much less than ordinary stellar distances.

A further advance in the investigation of the systematic motions of the stars has been made by Professor Dyson (*Proc. Roy. Soc. Edin.*, vol. xxviii. part. iii.). His results were obtained from the discussion of stars having large proper motions, distributed in all parts of the sky. The two favoured directions of motion were shown in a very striking manner, and were found to prevail in every region (including the part of the sky below  $30^\circ$  S. declination which had not previously been examined). In general, the investigation confirms and extends previous work on this subject; the principal divergence is in the position of the apex of the slower moving stream II.; there is also an indication that the velocity of this stream is rather greater than the value found from the Groombridge stars.

Professor Schwarzschild has made a great practical advance in the development of his theory (referred to in the last report), by